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Jurassic bryozoans from Baltów, Holy Cross Mountains, Poland

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Synopsis. Very few Jurassic bryozoans have been recorded from central or eastern Europe. This paper uses scanning electron microscopy to describe a well-preserved Polish Oxfordian bryozoan fauna consisting of five cyclostome species: *Oncousoecia* sp., *Reptomultisparsa norberti* sp. nov., *Hyporosopora baltovensis* sp. nov., *Mecynoecia suprabajocina* sp. nov. and *Apsendesia cristata* Lamouroux, 1821. Most abundant are specimens of *H. baltovensis* with tubular colonies which grew around perished cylindrical substrates. These arboreal colonies may have been epiphytes of algae or alternatively epizoans of sessile animals such as chaetopterid polychaetes, whose organic tubes can be similarly encrusted by bryozoans at the present-day. *H. baltovensis* is compared with other Jurassic species that have colonies with transversely ridged surfaces.

INTRODUCTION

The overwhelming majority of Jurassic bryozoans described in the literature are from western Europe, particularly England, France and Germany (see Walter, 1970). Knowledge of Jurassic bryozoans from elsewhere in the world is extremely limited, therefore, and any faunas from outside western Europe are worthy of attention. This is especially true if, as in the Polish fauna described here, the bryozoans are well-preserved and include new species.

The only previous paper concerning Jurassic bryozoans from Poland is that of Reuss (1867) which described 18 species (not including *Neuropora raristellata* Reuss; *Neuropora* is now regarded as belonging to the 'sclerosponges', see Kazmierczak & Hillmer, 1974) from the Upper Bathonian or Lower Callovian of Balin, near Cracow. Although Reuss's work is in need of revision, the Balin fauna is clearly different from that described here from the Oxfordian of Baltów. A few other species of Upper Jurassic bryozoans have been mentioned from the vicinity of Cmielów and Sobków on the north-western margins of the Holy Cross Mts (Malinowska, 1965; Pugaczewska, 1970).

Our purpose in this short paper is to describe the bryozoan fauna from Baltów, utilizing scanning electron microscopy (SEM), and to compare the species present with established species, especially from the better known, diverse faunas of the western Europe Middle Jurassic.

Material and methods. All studied specimens from Poland, which were collected during 1986–88, are deposited in the palaeontological collections of the Geological Museum of the Polish Geological Institute (Panstwowy Instytut Geologiczny) in Warszawa (MUZ PIG numbers). Comparative material from western Europe is in the collections of The Natural History Museum (BMNH register numbers). Specimens were studied and micrographs prepared using ISI 40A and ABT-55 scanning electron microscopes equipped with 'environmental chambers' for back-scattered electron imaging of uncoated material (see Taylor, 1986).

LOCALITY AND GEOLOGICAL SETTING

The Upper Jurassic of Baltów yields one of the most abundant and well-preserved cyclostome bryozoan faunas known from Poland. Baltów is situated approximately 15 km north-west of Ostrowiec Swietokrzyski on the north-eastern margin of the Holy Cross Mts (Fig. 1). The bryozoans come from coral-bearing deposits best exposed in the ravined part of the Kamienna River valley at Baltów.

A rich shallow water biota occurs at Baltów (Karczewski, 1960; Liszkowski, 1962, 1976; Roniewicz, 1966, 1968, 1976; Malinowska, 1967; Barczyk 1968, 1969, 1970; Roniewicz & Roniewicz, 1971; Hurcewicz, 1973; Brochwicz-Lewinski & Rózak, 1976; Maryanska & Kobylinska, 1980, 1984; Gutowski, 1992), including Foraminifera, bivalves, corals, brachiopods, sponges, ammonites, bryozoans, echinoids, crinoids, crabs, serpulid worms, shark teeth and algae (Rhodophycophyta of the genera *Solenopora*, *Parachaetetes* and *Polygonella*). A complex of coral-rich and other limestones is underlain by micritic, platy limestones containing: the bivalves *Gryphaea*, *Isognomon*, *Nanogyra*, *Trigonia* and *Pholadomya*; terebratulid and rhynchonellid brachiopods; ammonites; decapod claws; crinoids; and plant debris. The maximum total thickness reaches 100 metres (see Gutowski, 1992). The coralliferous limestone complex, approximately 15 metres thick, consists of unbedded or indistinctly bedded limestones overlain by bedded limestones (Roniewicz & Roniewicz, 1971). The former vary in thickness from 4 to 10 metres and comprise coral and pelitic limestones. According to Roniewicz & Roniewicz (1971), spaces between the foliaceous and submassive coral colonies are filled by pelitic or chalky limestones with a variable content of organic detritus. The bryozoans described here were collected from these weathered chalky limestones.

Ammonites have not been found in the bryozoan-bearing beds. However, thick-bedded micritic limestones underlying the coralliferous limestone complex contain ammonites of the *Gregoryceras transversarium* Zone, and oncolitic limestones overlying the complex contain ammonites of the *Perisphinctes bifurcatus*

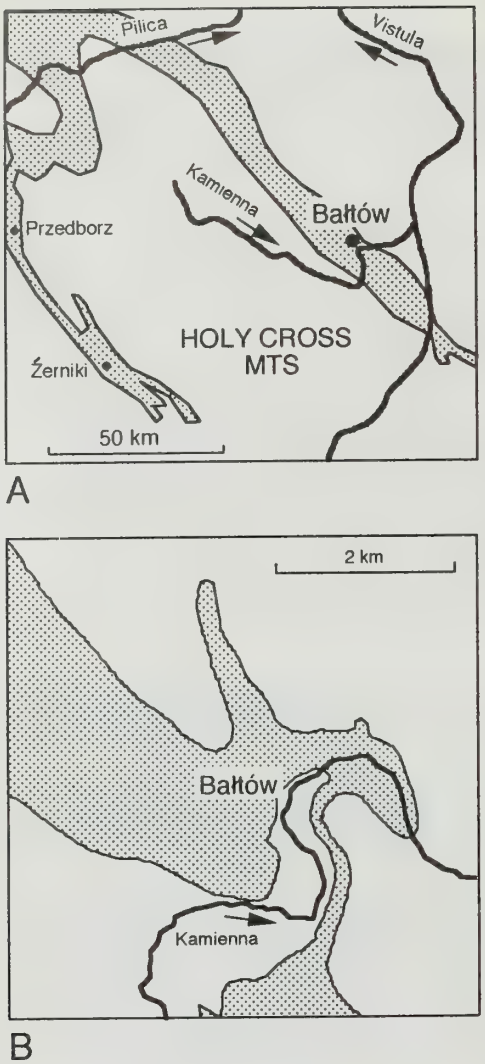

Fig. 1 Location of Baltów. **A**, map of the Holy Cross Mountains with the Upper Jurassic outcrop stippled (based on Roniewicz & Roniewicz, 1971). **B**, map of the Baltów area with the outcrop of the coralliferous limestone complex containing the bryozoan fauna stippled (based on Liszkowski, 1976).

Zone (J. Gutowski pers comm. to U.H., 1991). Therefore, the bryozoans belong to either the Transversarium or Bifurcatus Zone of the Middle Upper Oxfordian in the Submediterranean ammonite zonal scheme (Cariou *et al.*, 1971; Gutowski, 1992).

SYSTEMATIC DESCRIPTIONS

Order **CYCLOSTOMATA** Busk, 1852
Suborder **TUBULIPORINA** Milne-Edwards, 1838
Family **ONCOUSOECIIDAE** Canu, 1918
Genus ***ONCOUSOECIA*** Canu, 1918

TYPE SPECIES. *Tubulipora lobulata* Hincks, 1880 (=*Alecto dilatans* Johnston, 1847; see Hayward & Ryland, 1985), Recent.

REMARKS. Species assigned to *Oncousoecia* have encrusting colonies composed of narrow ramifying branches in which the zooids are arranged multiserially. Gonozooids are small to moderately large, and ovoidal or pyriform in shape. They are not pierced by autozooidal apertures.

Oncousoecia sp. Figs 2–3

MATERIAL. MUZ PIG 1601/II/8.

DESCRIPTION. Single colony comprising two coalescing branches detached from their original substrate.

Autozooids have frontal walls about 0.90–1.00 mm long by 0.25–0.35 mm wide, slightly convex distally but more immersed proximally. Apertures circular, about 0.11–0.15 mm in diameter, with short preserved peristomes tapering markedly distally. Pseudopores large, closely-spaced, often distally pointed. Faint transverse wrinkles on autozooid frontal walls continuous across colony surface.

Two gonozooids present, both asymmetrical as a result of distortion following branch coalescense (Fig. 2). Proximal frontal wall long and indistinguishable from that of an autozooid, raised strongly at its well-marked boundary with the dilated distal part of the frontal wall. Distal frontal wall roughly pyriform in outline, 1.10 mm long by 1.00 mm wide, slightly inflated in height, relatively smooth-surfaced and possessing a higher density of pseudopores than the autozooids. Ooeciopore subterminal (i.e. within the area of the dilated frontal wall), transversely elliptical, 0.07 mm long by 0.15 mm wide, about the same size as an autozooidal aperture. Ooeciostome short, slightly reflexed, bearing very few pseudopores (Fig. 3).

REMARKS. Walter (1970), in his major revision of Jurassic cyclostomes, described five species of *Oncousoecia*. The species from Baltów most closely resembles *O. elegantula* (d'Orbigny, 1850) from the Upper Bajocian of Port-en-Bessin, Normandy, France. However, *O. elegantula* has slightly narrower autozooids, a difference which might be significant given that frontal wall width is one of the more useful morphometric characters for distinguishing between species of Jurassic cyclostomes. In view of the sparse material available from Baltów and the need for SEM study of the type specimens of *O. elegantula* and other Jurassic species of *Oncousoecia*, specific determination of the Baltów specimen is deferred.

Family **MULTISPARSIDAE** Bassler, 1935
(= MACROECIIDAE Canu, 1918)
Genus ***REPTOMULTISPARSA*** d'Orbigny, 1853

TYPE SPECIES. *Diastopora incrustans* d'Orbigny, 1850, Bathonian.

REMARKS. Nomenclatural problems concerning the type species of *Reptomultisparsa*, misidentified when selected by Gregory (1896*b*), were discussed by Taylor (1984) and resolved by ICZN Opinion 1392 (1986) which designated *Diastopora incrustans* d'Orbigny as the valid type species. An earlier concept of *Reptomultisparsa* encompassing almost all multilamellar tubuliporine species has now been superseded by a concept based on the morphology of the gonozooids, which are longitudinally elongate and have large subterminal ooeciopores (see Taylor and Sequeiros 1982). Some, but not all species of *Reptomultisparsa* are multilamellar.

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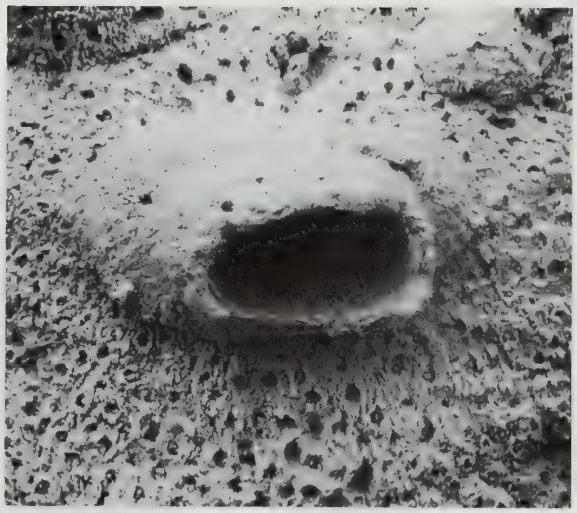

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Figs 2–3 *Oncousoecia* sp., MUZ PIG 1601/II/8, Oxfordian, Baltów, Poland. Scanning electron micrographs of uncoated specimen. **2**, distorted gonozooid and autozooids at coalescence of colony branches, × 45. **3**, ooeciopore, × 167.

Reptomultisparsa norberti sp. nov. Figs 4–8

HOLOTYPE. MUZ PIG 1601/II/1 (Figs 6–7).

PARATYPES. MUZ PIG 1601/II/2 (3 specimens).

NAME. In recognition of the contributions to bryozoology of the Austrian palaeontologist Dr Norbert Vavra.

DESCRIPTION. Colony multiserial, sheet-like, unilamellar, either planar (Fig. 4) or tubular (Fig. 5) in shape. Viewed from the growing edge the colony is thin, generally only one zooid in depth. Early growth stages unknown. Original substrates not preserved.

Autozooids immersed, zooidal boundaries indistinct, frontal walls flat for most of their length though slightly convex distally, about 1.10–1.50 mm long by 0.25–0.35 mm wide. Apertures widely-spaced, circular or a little wider than long, about 0.12 mm in diameter, occasionally closed by terminal diaphragms located at about the level of the frontal wall. Preserved peristomes moderately short, tapering distally. Pseudopores longitudinally elongate, slit-like when unworn (Fig. 8) but elliptical when worn.

Gonozooids apparently infrequent, only a single example having been found (Fig. 6). Distal frontal wall almost flat, longitudinally elongate, 1.50 mm long by 0.65 mm wide. Ooeciopore (Fig. 7) subterminal, larger than an autozooidal aperture, transversely elongate, 0.10 mm long by 0.25 mm wide.

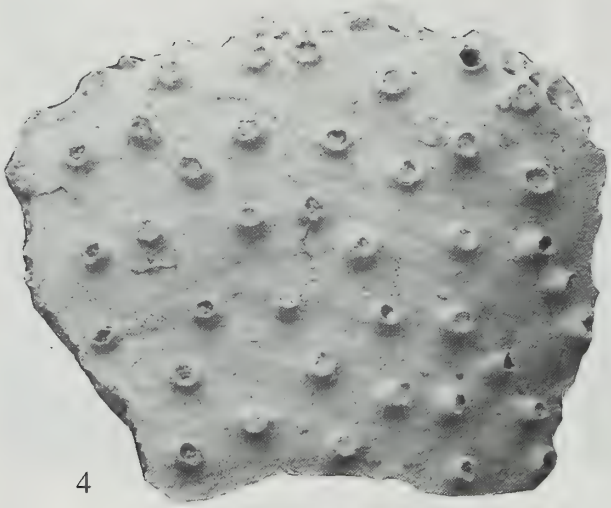
REMARKS. Walter (1970) assigned seven Jurassic species to *Reptomultisparsa*, and Taylor (1980) added one further new species. The autozooids in *R. cobergonensis* Walter, 1970, *R.*? *margopuncta* Waagen, 1867), *R. cricopora* (Vine, 1881), *R. oolitica* (Vine, 1881) and *R. tumida* Taylor, 1980, have distinctly convex frontal walls, unlike the rather flat frontal walls of *R. norberti*. *Reptomultisparsa encrustans* (d'Orbigny, 1850) differs from *R. norberti* in its much larger gonozooid, as well as its multilamellar colonies invariably encrusting gastropod shells once occupied by hermit crabs (Buge & Fischer, 1970; Taylor, 1994). *Reptomultisparsa ventricosa* (Vine, 1881), a species characteristic of the Aalenian and Bajocian of England, is more similar to *R. norberti* except for its inflated gonozooids with smaller ooeciopores, and subcircular pseudopores.

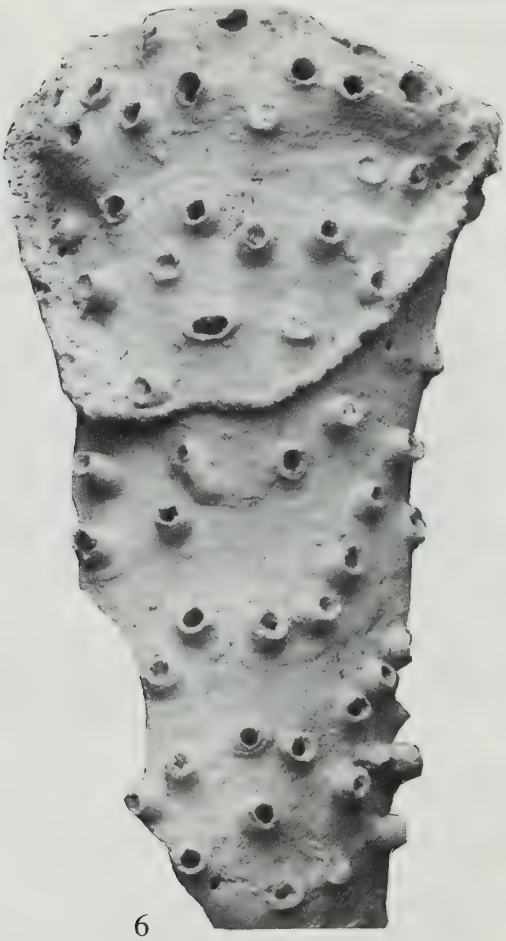
The unilamellar, often tubular colonies of *R. norberti* prompt comparison with *Diastopora*, notably the type species *D. foliacea* Lamouroux, 1821, from the Bathonian of Normandy. There are, however, striking differences in the form of the gonozooid, and in the morphology of the pseudopores as revealed by SEM. In *D. foliacea*, the gonozooid is transversely elongate and has lateral lobes which extend distally of the ooeciopore (Walter, 1970, pl. 8, fig. 1), whereas in *R. norberti* it is longitudinally elongate (Fig. 6). Pseudopores in frontal walls of *D. foliacea* zooids are gull-shaped (PDT unpublished), whereas those in *R. norberti* are long and slit-like (Fig. 8). These differences underscore the dual importance in cyclostome identification of specimens with gonozooids and of detailed SEM studies of pseudopore morphology. Without access to these two characters it is often difficult to make confident species determinations.

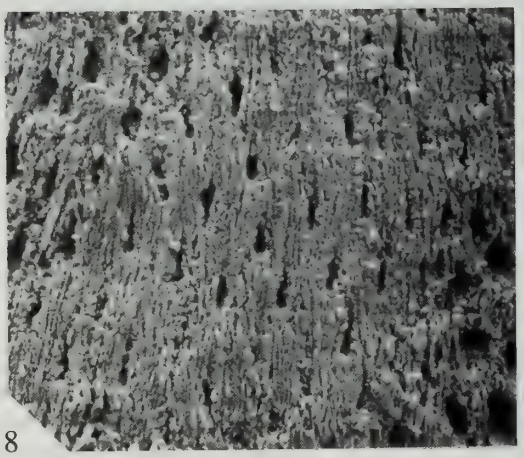
Family **PLAGIOECIIDAE** Canu, 1918
(= DIASTOPORIDAE Gregory, 1899)
Genus ***HYPOROSOPORA*** Canu & Bassler, 1929

TYPE SPECIES. *Hyporosopora typica* Canu & Bassler, 1929, Bathonian.

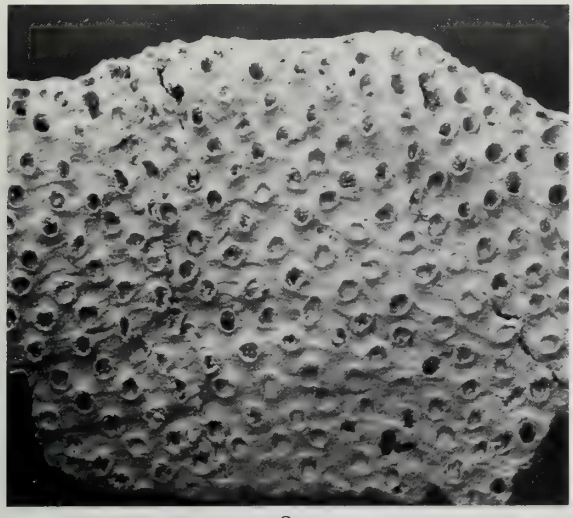
REMARKS. Although *Hyporosopora* was considered to be a junior synonym of *Plagioecia* Canu, 1918, by Walter (1970), differences exist between the two genera in the morphology of their gonozooids. Colonies of the extant type species of *Plagioecia*, *Berenicea patina* Lamouroux, 1816, have gonozooids with exceedingly broad, arcuate frontal walls which are profusely pierced by autozooidal apertures (see Hayward & Ryland, 1985). *Hyporosopora* gonozooids are considerably smaller, typically subtriangular in outline, and are not pierced by autozooidal apertures (see Taylor & Sequieros, 1982).







Figs 4–8 *Reptomultisparsa norberti* sp. nov., Oxfordian, Baltów, Poland. Scanning electron micrographs of uncoated specimens. **4**, MUZ PIG 1601/II/2 (2), paratype, lamellar colony, × 14. **5**, MUZ PIG 1601/II/2 (1), paratype, tubular colony, × 21. **6–7**, MUZ PIG 1601/II/1, **holotype**; **6**, autozooids and gonozooids of the fertile colony (ooeciopore just above calcite vein), × 15; **7**, detail of ooeciopore, × 138. **8**, MUZ PIG 1601/II/2 (1), paratype, slit-like pseudopores on autozooidal frontal wall, × 360.



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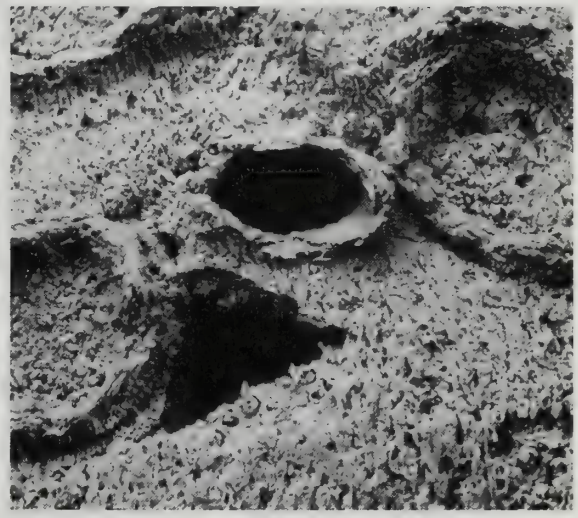

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Figs 9–12 *Hyporosopora baltovensis* sp. nov., Oxfordian, Baltów, Poland. Scanning electron micrographs of uncoated specimens. **9–10**, MUZ PIG 1601/II/13; **9**, lamellar colony, × 18; **10**, transverse ridges and autozooids, some with terminal diaphragms, × 64. **11–12**, MUZ PIG 1601/II/3, **holotype**; **11**, gonozooid, × 65; **12**, ooeciopore (triangular hole beneath is a breakage in the gonozooid frontal wall), × 225.

Hyporosopora baltovensis sp. nov. Figs 9–18

HOLOTYPE. MUZ PIG 1601/II/3 (Figs 11–12).

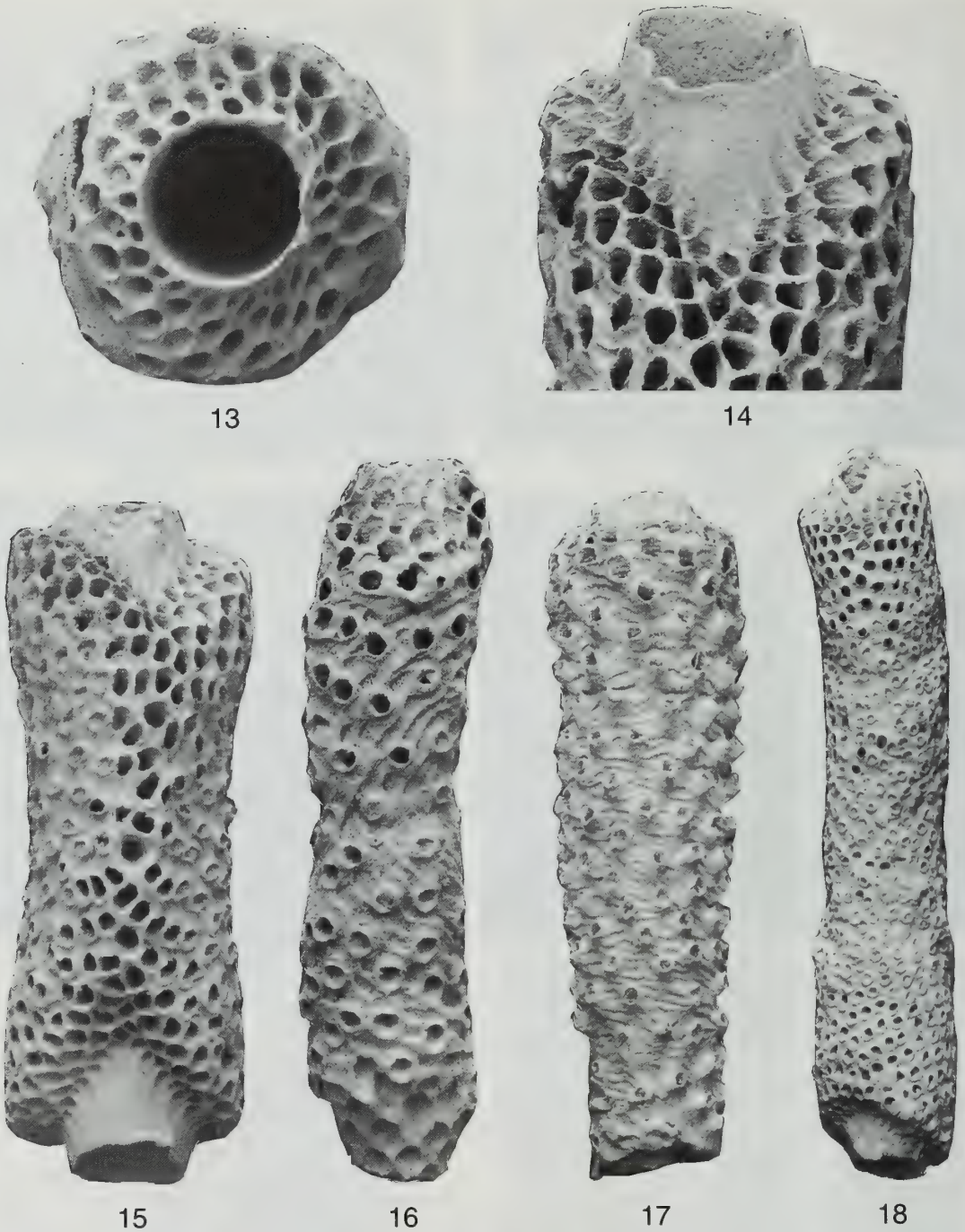
PARATYPES. MUZ PIG 1601/II/4 and 5, 13–18.

NAME. After Baltów, the type locality.

DESCRIPTION. Colony multiserial, sheet-like, bereniciform, commonly unilamellar but occasionally multilamellar, either planar (Fig. 9) or tubular (Figs 13–18) in shape. Tubular colonies possess a distinct suture formed by coalescence of lobes of the growing edge on opposite sides of the colony (Fig. 15). Distal fringe of basal lamina protrudes beyond budding zone at growing edge (Fig. 14) where two or three generations of zooidal buds, some with mural pustules, are visible. Colony surface ornamented by discontinuous transverse ridges, irregularly-spaced 0.02–0.08 mm apart, of low profile and sometimes indistinct, deflected proximally where they meet apertures (Fig. 10); ridges absent over dilated frontal walls of gonozooids (Fig. 11). Original substrates of encrustation not preserved.

Autozooids (Fig. 10) small, immersed, their frontal walls without well-defined boundaries, short, 0.25–0.50 mm in length by 0.11–0.17 mm in width. Apertures small, usually longitudinally elongate but sometimes transversely elongate or circular (especially near the edge of colonies), 0.08–0.17 mm long by 0.06–0.14 mm wide, arranged roughly in quincunx, closely-spaced and often crowded close to the colony perimeter where they are larger in diameter. Terminal diaphragms sporadic in distribution, positioned level with or a little beneath the frontal wall (Fig. 10), and also observed occluding immature buds at the growing edge (Fig. 13). Preserved peristomes moderately long, tapering distally. Pseudopores approximately circular in shape, widely spaced, absent on transverse ridges.

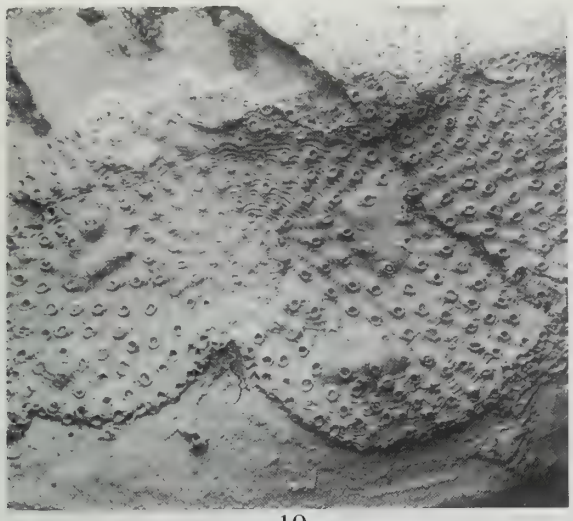
Gonozooids (Fig. 11) subcircular to subtriangular in outline, wider than long, averaging 0.60 mm in length by 0.90 mm in width,



Figs 13–18 *Hyporosopora baltovensis* sp. nov., Oxfordian, Baltów, Poland. Scanning electron micrographs of uncoated, tubular specimens. **13**, MUZ PIG 1601/II/14, end view showing hollow cavity originally occupied by a cylindrical substrate, × 50. **14–15**, MUZ PIG 1601/II/15; **14**, wide distal fringe of basal lamina, × 38; **15**, side view showing suture formed by anastomosis of opposite colony edges, × 23. **16**, MUZ PIG 1601/II/16, × 28. **17**, MUZ PIG 1601/II/17, × 20. **18**, MUZ PIG 1601/II/18, × 12.

inflated in height, lacking transverse ridges, indented by marginal autozooidal apertures. Floor of gonozooid pustulose, corrugated distally by the convexities of the underlying autozooids. Ooeciopore (Fig. 12) terminal, situated just beyond the inflated part of the gonozooid, small, transversely elongate, averaging 0.06 mm long by 0.09 mm wide, subcircular when the ooeciostome is preserved.

REMARKS. The main distinguishing feature of this new species is the presence of transverse ridges crossing the colony surface. Transversely ridged colonies also occur in four other Jurassic species: *Plagioecia rugosa* (d'Orbigny, 1853) from the Kimmeridgian of La Rochelle (France) (Figs 21–22), *Hyporosopora portlandica* (Gregory 1896*a*) from the Portlandian of southern England (revised by Taylor



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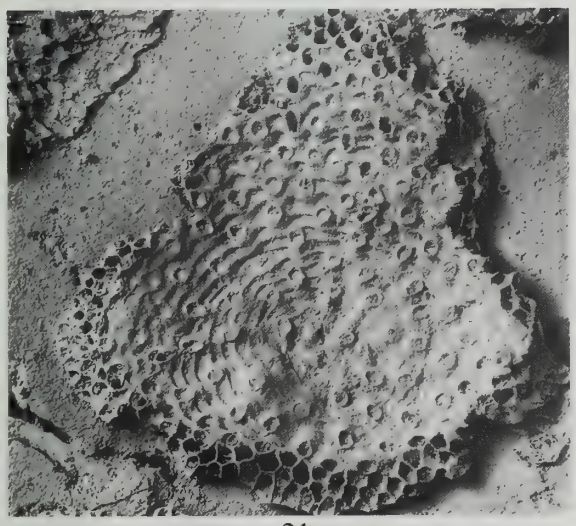

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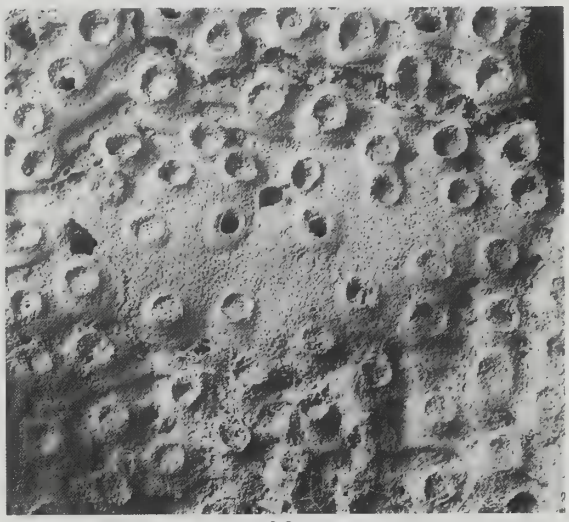

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Figs 19–22 Jurassic bereniciform cyclostomes with transversely-ridged colonies similar to *Hyporosopora baltovensis* sp. nov. **19–20**, *Hyporosopora enstonensis* (Pitt & Thomas, 1969), BMNH D51451, holotype, Bathonian, Hampen Marly Beds, Enstone, Oxfordshire, England; **19**, × 13; **20**, gonozooid, × 80. **21–22**, *Plagioecia rugosa* (d'Orbigny, 1853), BMNH BZ51, Lower Kimmeridgian, St Jean des Sables, near La Rochelle, Charente Maritime, France; **21**, small colony with prominent transverse ridges, × 14; **22**, gonozooid in a larger colony encrusting the same substrate, × 30.

1981), *H. enstonensis* (Pitt & Thomas, 1969) from the Bathonian of Oxfordshire (Figs 19–20), and *Mesenteripora undulata* (Michelin, 1845) from the Bathonian of Normandy (revised by Walter, 1970). A few post-Jurassic cyclostomes also possess transversely ridged colonies (e.g. *Plagioecia plicata* (Canu) from the Eocene of France, see Buge, 1979*a*; *Berenicea undata* Canu & Bassler, 1920 from Eocene of the USA), but this morphology seems to be proportionally less common than in the Jurassic.

Compared with *Hyporosopora baltovensis*, the gonozooid in *Plagioecia rugosa* is broader and is penetrated by autozooidal apertures (Fig. 22). In other respects, however, the two species are very similar, although the transverse ridges tend to be more strongly developed in *P. rugosa* (Fig. 21). Walter (1970: 218) considered *P. rugosa* to be a junior synonym of *Cellepora orbiculata* Goldfuss, 1826 from the Oxfordian of Streitburg in Germany. The syntypes (Universität Bonn, Goldfuss Collection 104) of *C. orbiculata* have been studied but are poorly-preserved, lack diagnostic gonozooids, and probably represent more than one species. *C. orbiculata* is probably better discarded.

Hyporosopora portlandica has narrower gonozooids than *H. baltovensis*, and autozooidal apertures which are more widely-spaced and frequently transversely elongate. Multilamellar growth, rarely seen in *H. baltovensis*, is very common in *H. portlandica*, resulting from either spiral overgrowth or eruptive budding of subcolonies onto the colony surface. (Note that the considerable discrepancy in autozooidal size between the holotype of *H. portlandica* and many other specimens previously assigned to this species, for example by Taylor (1981), suggests that more than one species may be present).

Gonozooid morphology is similar in *H. enstonensis* and *H. baltovensis*, but the former species has smaller autozooids and more prominent transverse ridges (Figs 19–20). *M. undulata* has consid-

erably larger autozooids, and some colonies apparently develop erect growth (Walter, 1970, pl.10, figs 3–8).

In view of the paucity of potential characters for grouping Jurassic bereniciform cyclostome species into genera, consideration must be given to the possibility of using the presence of transverse ridges as a generic character. All of the transversely ridged species seem to be closely-related and are classified within the Family Plagioeciidae. However, they are currently distributed between two or three different genera. Practical problems are associated with the recognition of transverse ridges because, although the ridges are sharp and clearly-defined in some species (e.g. *H. enstonensis*), in others (e.g. *H. baltovensis*) they are gradational with irregular growth checks of the sort which can be found in a wide range of bereniciform cyclostomes. A more complete analysis of character distributions is recommended before any attempt is made to group transversely-ridged species into one genus.

Genus ***MECYNOECIA*** Canu, 1918

TYPE SPECIES. *Entalophora proboscidea* Milne-Edwards, 1838, Recent.

REMARKS. Although Canu (1918) named *E. proboscidea* Milne-Edwards, 1838, as the type species of *Mecynoecia*, Canu & Bassler (1922: 11) attempted to change the type species to *Pustulopora delicatula* Busk, 1875, stating: 'The widespread and abundant species *Entalophora proboscidea* Milne-Edwards, 1838, was cited as the type of the genus by Canu in 1918, but we have changed the genotype for the reason that several species with different kinds of ovicells are undoubtedly included under this name and it is perhaps impossible at present to determine which one Milne-Edwards described'. This amendment is inadmissable under the International Rules of Zoological Nomenclature and therefore *E. proboscidea* stands as the valid type species of *Mecynoecia* (see also discussion in Buge 1979*b*; Walter 1987).

The probable type specimen of *E. proboscidea* (Museum Nationale d'Histoire Naturelle, Paris, Risso Collection 5110) has been examined by PDT. Although its colony-form corresponds with the general usage of *Mecynoecia* (e.g. by Harmelin 1976), the specimen lacks gonozooids, thus making precise characterization difficult, a problem considered beyond the scope of the current paper which accepts the generic concept as customarily applied.

Mecynoecia suprabajocina sp. nov. Figs 23–26, 28

HOLOTYPE. MUZ PIG 1601/II/11 (Figs 23–25).

PARATYPES. MUZ PIG 1601/II/9 and 10.

NAME. Indicating its similarity with *M. bajocina* (d'Orbigny, 1850) and the higher stratigraphical occurrence.

DESCRIPTION. Colony erect, branches cylindrical (vinculariiform) and narrow (Fig. 23), 1.0–1.2 mm in diameter, ramifying dichotomously. Growth tips low cones in profile, with a radial, spoke-like arrangement of interzooidal walls, visible when viewed from above (Fig. 28). Zooidal budding apparently centred on branch axis. Pseudopores densely-packed and subcircular, absent from broad bands at the zooidal boundaries (Fig. 24).

Autozooids with elongate frontal walls, about 1.0 mm long by 0.21–0.30 mm wide, slightly convex distally but sunken beneath the level of the zooidal boundary wall proximally. Apertures widely-spaced, circular or a little longitudinally elongate, about 0.12–0.14 mm in diameter, sometimes closed by a terminal diaphragm located either atop a short peristome or inclined and positioned proximally to the peristomial rim.

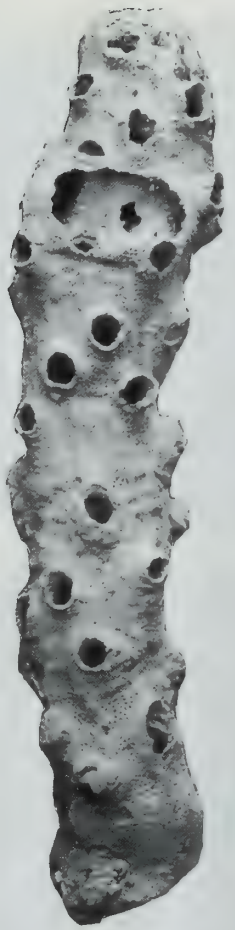
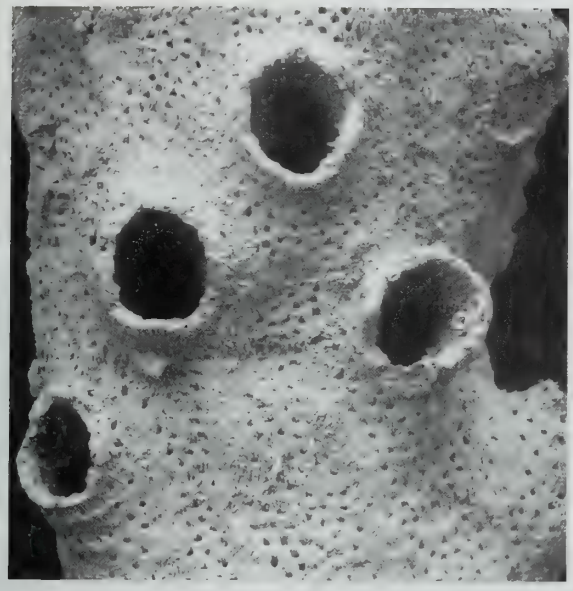


Fig. 23 *Mecynoecia suprabajocina* sp. nov., MUZ PIG 1601/II/11, **holotype**. Oxfordian, Baltów, Poland. Scanning electron micrographs of uncoated branch with a broken gonozooid close to the distal end, × 21.

Gonozooids (Fig. 26) with globular distal dilated frontal wall, subcircular or transversely elliptical in outline and well inflated. Ooeciopore (Fig. 26) located terminally, more or less semicircular, distal edge markedly convex relative to the almost straight proximal edge, wider than long, about 0.10 by 0.17 mm. Preserved ooeciostomes short.

REMARKS. This new species resembles *Mecynoecia bajocina* from the Upper Bajocian White Sponge Oolite of the Port-en-Bessin area of Normandy, and the contemporaneous Microzoa Beds (a facies of the Burton Limestone) of Shipton Gorge, Dorset. However, it differs from *M. bajocina* in the structure of the ooeciopore which is almost semicircular (Fig. 25) compared to the ooeciopore of *M. bajocina* which is very strongly compressed medially (Fig. 27). In addition, the zooidal boundary areas devoid of pseudopores are substantially wider in *M. suprabajocina* than in *M. bajocina*. Genetic studies of living ctenostome and cheilostome bryozoans have shown clearly that subtle morphological differences signify different species (e.g. Thorpe & Ryland, 1979; Jackson & Cheetham, 1990). Although comparable studies have yet to be made on Recent cyclostomes, it is considered reasonable to favour the taxonomic splitting of cyclostomes on the basis of small but consistent differences in skeletal morphology (e.g. McKinney & Jackson, 1989).



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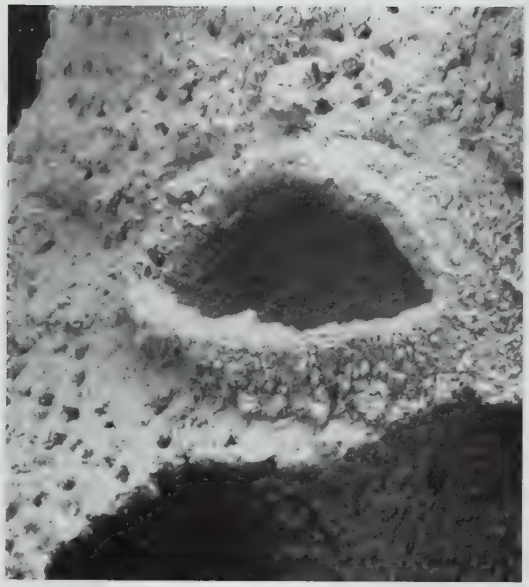

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Figs 24–27 Jurassic *Mecynoecia*; scanning electron micrographs of uncoated specimens. **24–26**, *Mecynoecia suprabajocina* sp. nov., Oxfordian, Baltów, Poland; **24–25**, MUZ PIG 1601/II/11, **holotype**; **24**, autozooids with broad areas devoid of pseudopores at zooidal boundaries, × 85; **25**, ooeciopore, × 200; **26**, MUZ PIG 1601/II/10, paratype, gonozooid with intact frontal wall, × 65. **27**, *Mecynoecia bajocina* (d'Orbigny, 1850), BMNH D59492, Upper Bajocian, Shipton Gorge, Dorset, England, gonozooid with typically compressed ooeciopore, × 55.

Family **THEONOIDAE** Busk, 1859
Genus ***APSENDESIA*** Lamouroux, 1821

TYPE SPECIES. *Apsendesia cristata* Lamouroux, 1821, Bathonian, Normandy.

REMARKS. Only two species of this genus are recognized: the Jurassic type species and *A. neocomiensis* d'Orbigny from the Hauterivian.

Apsendesia cristata Lamouroux, 1821 Figs 29–32

1821 *Pelagia clypeata* Lamouroux: 78, pl. 79, figs 5–7.
1821 *Apsendesia cristata* Lamouroux: 82, pl. 80, figs 12–14.
1854 *Apsendesia cristata* Lamouroux; Haime: 201, pl. 7, fig. 6 a–k.
1854 *Apsendesia clypeata* (Lamouroux); Haime: 202, pl. 7, fig. 7 a–d.
1896*c* *Apsendesia cristata* Lamouroux; Gregory: 167, pl. 9, figs 4–5.

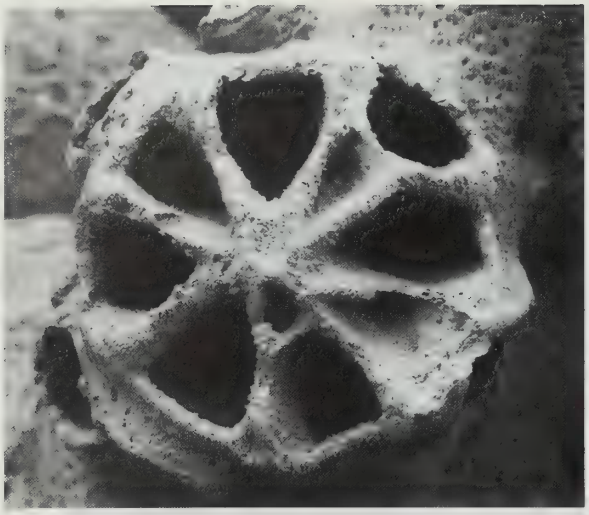

Fig. 28 *Mecynoecia suprabajocina* sp. nov., MUZ PIG 1601/11/9. Oxfordian, Baltów, Poland. Scanning electron micrograph of branch growing tip showing spoke-like arrangement of zooecial walls, × 85.

1953 *Apsendesia cristata* Lamouroux; Bassler: 56, fig. 23,4.
?1967 *Apsendesia cristata* Lamouroux; Walter: 46, pl. 10, figs 1–2.
1970 *Apsendesia cristata* Lamouroux; Walter: 202, pl. 20, figs 6–11.

MATERIAL. MUZ PIG 1601/II/6-7.

DESCRIPTION. Colony erect, fungiform, a narrow stalk, about 0.8 mm long, supporting an expanded, cup-shaped head, subcircular in plan view and averaging 4 mm in diameter (Figs 29–30). Autozooids grouped into fascicles which open around the circumference of the head and increase in number through bifurcation. Frontal side of head marked radially by ridge-like fascicles and convex frontal walls of autozooids. Underside of head an exterior wall with pseudopores and concentric growth lines, sometimes giving rise to downward-growing processes or struts each composed of about 3–6 zooids (Fig. 31).

Autozooids long, lacking frontal walls and with polygonal apertures when situated in the centres of a fascicle, but possessing pseudoporous frontal walls and apertures with a curved external edge when situated at the border of a fascicle. Apertures about 0.15 mm in diameter.

Gonozooids not observed in specimens from Baltów (see below).

REMARKS. This is one of the most distinctive of all Jurassic bryozoan species. At Baltów only small colonies, resembling specimens from the French Bathonian described as *Pelagia clypeata* by Lamouroux (1821), have been found. Large colonies depart from a simple cup-shape and become complexly corrugated, like the specimen described as *Apsendesia cristata* by Lamouroux (1821).

The finding of *A. cristata* at Baltów in the Oxfordian extends its range upward from the Lower Callovian (Walter, 1970: 204). An apparent occurrence in the Upper Bajocian of Shipton Gorge (Walter, 1967) is questionable: specimens from Shipton Gorge are extremely small, consisting of little more than a stalk and lacking the characteristic head and fascicles.

The peculiar gonozooid of *A. cristata*, not found in specimens from Baltów, is illustrated here using SEM for the first time (Fig. 32). It develops within a cleft in a fascicle and has a small ooeciopore situated in the centre of a bulbous frontal wall. Another unusual feature of *A. cristata* are the processes which may develop from the undersides of colonies (Fig. 31). These are multizooidal, originate at the growing edge (i.e. not by resorption of the exterior wall in more proximal sites), and may extend down to the substratum to form secondary supports for the colony. Voigt (1993) has described similar structures from a variety of other cyclostomes and cheilostomes.

PALAEOECOLOGY

The Baltów bryozoan fauna consists entirely of small, delicate colonies; there is a total absence of the larger, more robust cyclostomes, notably cerioporines, which characterize many other Jurassic bryofaunas. In this respect, the fauna resembles that found in the Upper Bajocian of Shipton Gorge (Walford, 1889, 1894; Walter, 1967), although known species diversity at Shipton Gorge is considerably greater (*ca* 19 spp., vs. 5 spp. at Baltów). Other similarities between the two faunas include the abundance of bereniciform colonies with narrow axial canals, and the shared presence of closely-related species of *Mecynoecia* (and possibly also *Apsendesia cristata*, but see note above). Walter (1967) interpreted Shipton Gorge as a low energy, shallow water environment in which many of the bryozoans grew attached to thin algal filaments. A similar environmental interpretation probably also applies to Baltów, as suggested by the bryozoans (see Maryanska & Koblinska, 1980, 1984), corals (see Roniewicz & Roniewicz, 1971) and brachiopods (e.g. Barczyk, 1968, 1969, 1970). The presence of calcareous algae certainly implies deposition within the photic zone.

Most specimens of *H. baltovensis* from Baltów have tubular colonies with narrow axial canals (Figs 13–18). This colony-form is not, however, a specific character of *H. baltovensis* as some colonies are flat (Fig. 9). The presence of axial canals is clearly a result of encrustation of cylindrical substrates which were soft bodied and did not fossilize. Indeed, axial canals identical in size to those of *H. baltovensis* can be found in sponges from Baltów, which presumably lived attached to the same substrates as the bryozoans. Occasionally, the axial canals bifurcate, indicating that the organisms concerned had Y-shaped branches. Unfortunately, no informative bioimmurations of the surface details of the perished substrates are present on the basal laminae of the bryozoans. Therefore, the identity of the substrate is equivocal. Recent bryozoans can grow around a variety of cylindrical substrates of both plant and animal origin. For example, Alvarez (1992: fig. 15) illustrated small colonies of the Recent cyclostome *Disporella* sp. growing around un-named cylindrical substrates and leaving axial canals very similar to those found in the Baltów specimens. Bone & James (1993: fig. 7b) figured several different species of bryozoans attached to the cylindrical stems of sea-grasses from shallow water environments of the Lacepede Shelf, southern Australia. Larger diameter axial canals result from growth of the cheilostome *Schizoporella floridana* around rhizomes of seagrass (see McKinney & Jackson 1989: fig. 7.12). Among living animals, the polychaete *Phyllochaetopterus socialis* living at depths beneath the photic zone on the Otago Shelf of New Zealand constructs long horny tubes about 1 mm in diameter. These tubes are fouled by a diversity of bryozoans, including encrusting cheilostomes and cyclostomes, as well as erect colonies of the cyclostomes *Telopora* and *Hornera* (P.D.T. unpublished). Colonies wrap around the circumference of the polychaete tubes. Tube decay would leave an axial canal in the centre of the colony. Some of the tubes divide, possibly as a result of asexual fission of the worms

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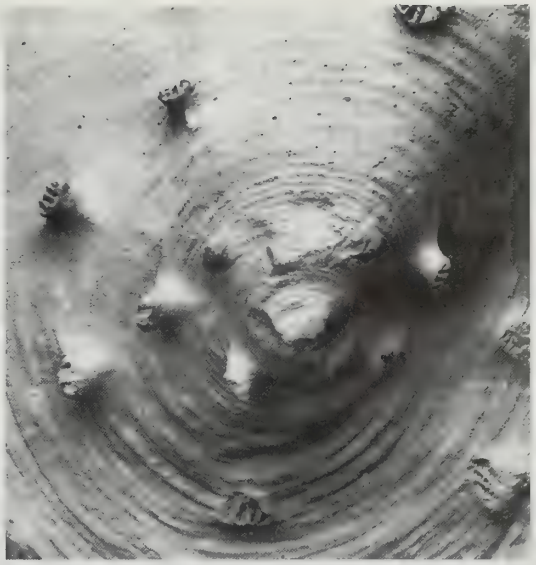

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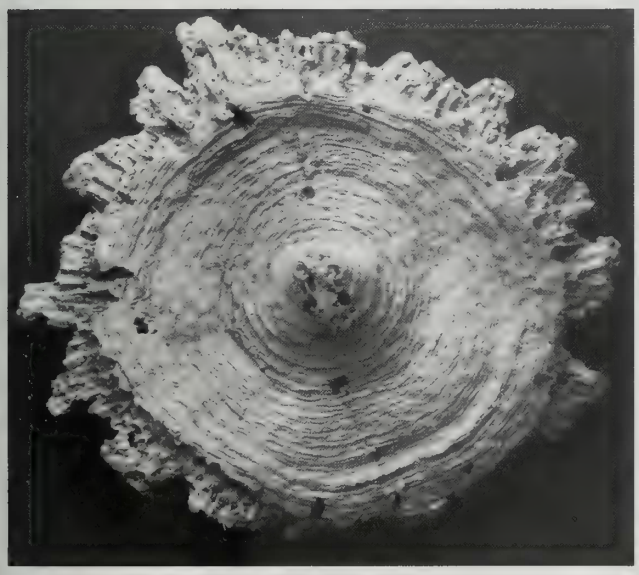

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Figs 29–32 *Apsendesia cristata* Lamouroux, 1821. Scanning electron micrographs of uncoated specimens. **29–30**, Oxfordian, Baltów, Poland; **29**, MUZ PIG 1601/II/6, colony upper surface, × 15; **30**, MUZ PIG 1601/II/7, colony underside, × 15. **31–32**, BMNH D2327 (1), Bathonian, Ranville, Normandy, France; **31**, struts on the underside of a colony, × 15; **32**, gonozooid between fascicles of autozooidal apertures, × 35.

Therefore, caution should be exercised when inferring that fossil bryozoans with axial tubes grew attached to plants and therefore indicate palaeoenvironments within the photic zone.

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